FINAL REPORT FOR NAS5-32073

The scientific focus of this program was the broad-band spectroscopic study of the so called soft x-ray transients (SXTs) using, primarily, data obtained with Compton Gamma-Ray Observatory (CGRO) and the International Ultraviolet Explorer (IUE). These are objects which spend most of their lifetimes in a quiescent state during which they are extremely faint, and often un-detectable. They undergo episodic accretion driven events which can be quite dramatic. One such source, GRO J0422+32, is for example at the time of its outburst peak became the second brightest source in the x-ray sky and the brightest source ever detected by CGRO at 200 keV. SXTs are a subset of the class of x-ray sources known as low mass x-ray binaries, the canonical picture for which is a dwarf, red, main sequence secondary in close orbit about a compact (neutron star or blackhole) primary. The ultraviolet luminosity of these objects is dominated by emission from an x-ray heated accretion disk, and as such is crucial to detailed modelling of the accretion dynamics. Indeed, it has been demonstrated through coordinated x-ray and UV study of steady low-mass binary sources that the UV, not the x-rays, provides the most accurate measure of the accretion rate. Additionally, the UV contains a number of high and intermediate excitation emission lines characteristic of photo-ionized or high velocity material. Since SXTs evolve quite rapidly (the x-ray light curves typically decay with an e-folding time of order one month) it is crucial that an observing program be planned and executed on short notice. We were successful in this case, as a firm optical-spectroscopic confirmation of the stellar counterpart to the x-ray source preceded the first IUE observations by only a matter of hours!

The initial observations strongly support the low-mass binary picture, revealing a blue continuum, approximating the canonical accretion disk picture, superposed with high-excitation emission lines. The results were reported within 24 hours to the International Astronomical Union, to be published as an IAU telegram. We have subsequently performed further analysis leading to source distance estimates, constraints on the orbital inclination of the binary system, on the overall energy budget and kinematics of the accretion flow. Additionally, the UV-color dependence of the decay light curve, in particular for the "secondary" maximum, was established - the disk gets bluer with intensity. This is directly contrary to what is expected from theory, and imposes a significant new constraint.

In a separate study carried out under this project, we were able, making use of data from the CGRO, archival data from the Goddard High-Energy Astrophysics Science Archive Center as well as the HST Sky-Survey Plate archive, we were able to identify a counterpart of another CGRO transient GRO J1008-57. Our analysis in this case revealed significant constraints on physical properties of the system such as the neutron star magnetic field strength and the orbital period.

Additional work, which has been only partially completed under this project, involves a separate transient AO535+26. Three separate outbursts of this system have been well documented by CGRO, and we also have obtained extensive UV coverage of the most significant of these events using IUE. Analysis of the data is ongoing, but preliminary results indicate that color and intensity dependence on X-ray luminosity has been established, which we are interpreting as a diagnostic of the size and density of the circumstellar disk.